

Economic Analysis of Research Results Part 1:

The Use of Economic Analysis in Researcher Managed Trials

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1. Why do an Economic Analysis?

Researchers only need to be concerned about economic analysis of trials if they wish to go beyond testing the technical aspects of a technology. That is if they also wish to check whether these technical responses are likely to be useful to and used by farmers. However technically sound a new technology may be, farmers will only use it if it is also economically attractive.

Most researchers will be aiming to develop technologies or recommendations that farmers find useful, but there are a number of implications of going beyond the technical evaluation of trials that researchers are not always aware of. A more obvious implication is that trial treatments need to be evaluated for their economic response. However to make a meaningful economic evaluation of trial treatments it becomes important to pay attention to a number of other considerations:

- a) unless a completely new crop is being introduced into a system, farmers already employ a set of production techniques and any technology to be introduced implies them changing from their current practice to the new one. Thus to evaluate the new technology we must know how it performs relative to farmers current technology. The implication is that one of the levels of any experimental variable must represent the farmer's current practise if an economic evaluation is to be meaningful.
- b) by the same logic, non-experimental variables should be set at current farmer levels, so that the response of the treatment reflects the response that farmers can expect if they make the change to the new technology.
- c) the above considerations lead us onto thinking about what the production conditions are for our target farmers. Non experimental variables can be considered to encompass managerial, technical, environmental and economic circumstances. Managerial, technical and environmental factors will influence the level of technical response from any treatment. Economic factors will determine how attractive this level of technical response is for target farmers.

Thus unless researchers have a clear idea about their target

farmers and the circumstances in which they operate, the prices they face etc., as well as their current management strategies and production practices, economic analysis of experimental treatments are not very meaningful. Furthermore, it is necessary to have an idea about response levels in relation to current farmer practise (for both experimental and non experimental variables) before economic analysis can be useful. Ultimately, economic and risk analysis should be conducted on treatments managed by farmers in their own fields. Only at this point will the responses and thus economic returns provide a true reflection of what farmers can expect.

In the absence of an economic analysis researchers are unable to go beyond assessing the technical aspects of treatments. They are not able to go further and assess the acceptability of treatments for target groups of farmers. In summary then we can say that:

- a) economic analysis is required if researchers are interested in assessing whether treatments will be useful to farmers
- b) economic analysis can guide the selection of treatments and levels in early stages of experimentation
- c) final assessment of the value of any treatment to farmers must be conducted under similar natural and management circumstances in which the target farmers operate and comparisons made against levels of the treatment currently used by farmers.

In this paper we will use results from a fertiliser trial to illustrate some of the aspects of employing an economic analysis to assess early stage trials and assist in making decisions about the redesign of the trial in subsequent stages. In this section we will outline a number of the steps needed to prepare trial data for and to conduct a meaningful economic analysis.

2. Using Economic Analysis to Guide Trial Design

At early stages of experimentation, researchers will often be most interested in establishing technical relationships. Here non experimental variables will seldom be at farmer levels and often none of the levels of the experimental variables will have been chosen to reflect current farmer practice.

Economic analysis at this stage can still be helpful, even though it would not be aimed at making recommendations for farmers. At this stage economic analysis may be regarded as a screening procedure, assisting with decisions on which treatments are worth considering in more detail and which should be clearly discarded from subsequent trials. It can also provide insights on the importance of practical issues (such as the form in which N is applied), which may not influence the technical response very much, but may have a profound impact on the economics of the treatment.

Factors or levels of experimental variables that do not exhibit consistent and clear statistical yield responses under researcher managed conditions will generally be even less likely to do so under farmer conditions and can be rejected without further

economic analysis unless the treatment saves costs or is likely to give better responses under farmer management. Responses that are statistically significant and consistent may still not be sufficiently large to provide economic benefits. Economic analysis is needed to check this. Treatments that are clearly uneconomic can also be safely omitted from further consideration, since the levels of response obtained by researchers will usually be higher than farmers will achieve.

A key consideration at this stage is the target group for which the trials are being conducted. In order to assess both the agronomic and economic results it is necessary to have a clear idea of:

- a) how representative the trial sites were of the fields of the target farmers
- b) how representative the rainfall was relative to what target farmers can expect most years
- c) how representative the non-experimental variables were of the practices most commonly used by the target farmers
- d) what are the current farmer level of the experimental variables are.

Economic analyses can only be helpful in making decisions on what treatments to maintain in further research and what treatments or levels to discard if researchers have a clear idea of how the conditions leading to their trial results compare with those generally experienced by the target farmer group.

2.1 Preparing Agronomic Results for Economic Analysis

A number of fairly self evident steps are required to prepare data for economic analysis. Not all the results obtained from agronomic and statistical analysis should be subject to economic analysis. For some results an economic analysis is unnecessary, for others it is not meaningful and for others the interpretation will be very difficult. To select the results that are worth subjecting to economic analysis and to enable a meaningful interpretation, the following steps should be followed

2.1.1 Review trial description

The description of the trial should include its objectives, experimental design, experimental treatments and levels of non-experimental variables and management. It should also include a list of data to be collected from the trial to measure responses, explain responses and observations on management of the trial.

This review should enable an assessment to be made of how representative the trial was of the conditions under which the target farmers would use the experimental treatments and how much adjustment needs to be made in assessing the economics of the treatments under farmer conditions.

2.1.2 Selection of sites to be included in the Analysis

Sites that are clearly not representative of the target farms should be rejected from the analysis. Sites that are representative of the target farms, but exhibit differences in response should be considered for combining into subgroups. Combination into subgroups should be based on clearly defined criteria:

- significant and large site by treatment interactions in the ANOVA should be the major basis for considering regrouping
- heterogeneity of error variance between sites should not dictate recombination (account can be taken of heterogeneity by adjusting degrees of freedom)
- sites should only be regrouped on the basis of large treatment by site interactions if explanatory factors can be found that explain the differences in response at the different sites and if these factors can be predicted in advance.

Where there is justification for recombining sites into subgroups, economic analysis should be performed on each subgroup of sites separately.

2.1.3 Selection of response means to be included in the analysis

It is only necessary to perform a full economic analysis if the response means of a pair of treatments are significantly different from each other (e.g. at the 5% level). If the means are not significantly different, the cheaper of the two treatments would be the most economic and it is only necessary to consider the difference in costs between the two treatments.

Economic analysis should only be performed between any pair of treatment means that exhibit significant differences if this response to experimental treatments can be explained in relation to commonly accepted agronomic principles. If the treatment response cannot be explained agronomically, it will not be possible to interpret the economic results.

2.2 Performing Meaningful Economic Analysis

Economic analysis of treatments in a trial involves making a comparison of the changes in value of increased production with the changes in costs required to generate that increased production. Where the changes in value of increased production outweigh the changes in costs between the two treatments the more costly/higher output treatment is to be preferred - and vice versa.

Clearly the values applied to the increased output (output prices) and the costs of inputs can influence the outcome of the economic analysis as much as the treatment responses themselves. Getting the input and output prices right is critical in making a meaningful economic analysis. Market prices can usually be used as a guide to farmer field level prices, but will generally have to be adjusted to reflect the real prices farmers will have to pay for inputs and can expect to receive for their outputs. Account needs to be taken of the costs of getting produce from the field to the market and the costs of getting the inputs from the market to the field. Consideration also needs to be given to the form in which farmers will apply a treatment on their fields and the input should be priced accordingly. Researchers often express fertiliser treatments in terms of kilograms of nutrient. Economic assessment of the economics of these treatments must be based on the cost of the nutrient in the fertiliser farmers will apply, which may not be the same as that used by the researchers in their trials.

Farmers will seldom be content to make an investment in cash if the returns just cover the cash outlay. They will look to obtain a return to any cash invested that is at least as good as the alternative use of that cash. Very often farmer's minimum acceptable return on cash will be in excess of 50%. This cost needs to be factored into the analysis.

Farmers will seldom be interested only in average returns. They will also be concerned with the variability of those returns from field to field and season to season. Some idea of how returns to investments in a treatment are likely to vary across fields and seasons is necessary to assess its acceptability to farmers.

In many cases it will be sufficient to assess the economics of moving from one treatment to another. There may be cases when researchers need to have some idea of what level between two treatments is most economic. Continuous, production function analysis can be conducted to provide this information, but is subject to the same caveats about pricing and costs as above and, in addition, is dependent on fitting an acceptable response function to the response data.

2.3 Interpretation of economic analysis results

Economic analysis often involves the use of assumptions on the amounts and costs of inputs required to implement a treatment. This is especially the case where the input costs involve labour inputs and where this assumed change in labour requirement is costed at an implicit opportunity price of family labour.

Economic analysis giving marginal results should be subject to sensitivity analysis in respect of the major cost items, to test how sensitive the obtained result is to the assumptions made about cost changes. Some treatments will still be clearly uneconomic, whatever reasonable assumptions are made. Serious consideration should be given to discarding these treatments from further trials even though consistent and significant output responses were obtained. Other treatments will be clearly economic and consideration should be given to including more costly treatments in the next round of trials. However treatments that appear to be clearly economic under researcher managed conditions may turn out to be uneconomic under farmer managed conditions where the levels of response are lower, but the costs the same. Only those treatments that are clearly economic under researcher management should be considered for inclusion in farmer managed trials.

With these considerations, economic analysis can provide a useful additional tool for assessing the potential value of treatment variables for a target group of farmers. This assessment may be used to redesign researcher managed trials towards more appropriate treatments in future work or to move trials from the researcher managed to the farmer managed stage. Conducting an economic analysis forces researchers to compare treatment performance against current farmer practice, since this is the only economic assessment that makes sense. In doing so it raises the issues of target farmers and the nature of their production circumstances. Apart from the results obtained, thinking through the meaning and implications of conducting an economic analysis is an effective way for researchers to assess the relevance of their work for their client farmers. The next part of this paper illustrates how an economic analysis was used to assist in the interpretation of the results of a maize fertiliser trial in Zimbabwe.

Notes

- 1) Where previous work has shown that one experimental factor is highly economic, it may be justifiable to test a second factor with the first (non-experimental) factor set at the level farmers are expected to adopt. Thus a stepwise adoption pattern may be developed. But the starting point must be tested against a non-experimental background which reflects farmer current practice levels.